ELEC/MSNE/CHEM 661: NANOPHOTONICS, SPECTROSCOPY, AND MATERIALS FOR SUSTAINABILITY (Fall 2015)

Instructor:

Prof. Isabell Thomann
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Office hours: by appointment - please e-mail me or see me after class.

Course Grader:

TBA

Class Hours:

12.00 – 1.15pm, MF, location: MLC 104

Course website:

https://owlspace-ccm.rice.edu/portal/site/CHEM-ELEC-MSNE-661-001-F15

Course Description:

This course will cover the contributions that nanophotonic concepts and advanced spectroscopy techniques can make to the development and characterization of novel materials for energy and sustainability. We will cover nanophotonic concepts for novel materials and characterization techniques, ultrafast and nanoscale spectroscopy techniques, and applications in energy and sustainability. For each topic, I will provide background information about the relevant science and engineering aspects. Then we will examine the state-of-the-art in the topic, via student-presentations and literature reviews.

Overall course objectives and expected learning outcomes:

Objective: Students will learn the fundamentals of solar energy conversion devices. Based on this foundation, we will cover the state of the art in materials synthesis, characterization, and performance, for applications in energy and sustainability. Students will also explore how nanophotonics concepts and advanced spectroscopy techniques can help to address challenges related to sustainability. They will further develop presentation skills, by preparing their own presentations, and by constructively criticizing presentations by others. They will also develop scientific writing skills by preparing a report on a selected topic.

Outcome: Students completing the course should:

1. Be able to explain the principles and materials requirements for solar energy conversion devices.

2. Design their own time-resolved or nanophotonic spectroscopy approach to gather information on materials for sustainability. Design materials and device architectures for energy and sustainability applications.

3. Be able to judge the feasibility, performance and limitations of new device concepts, materials, and analytic tools for applications in energy.

4. Be able to prepare scientific presentations and reports on a current research topic in materials for energy, and efficiently search the scientific literature to find required background information.

5. Be in a position to develop their own research/engineering interests in the above areas.

List of required texts:

There is no required textbook. I will point to background reading materials where appropriate.

Grade policies:

Grades will be based on: Presentation 1 (25%), presentation 2 (25%), and your written report on a selected topic (20%). There will be a 50% penalty on handing in presentations/ reports late. There will be in-class quizzes (15%) which will be easy if you are around, and participation during class will count for 15%.

Each student will give two presentations, each on a topic broadly related to what has been / will be discussed in the lecture, or extending what we have discussed. You can come up with your own suggestions for topics, and I will see if this is acceptable or tell you how I want you to modify the topic. We will also have a list of suggested topics, from which you can choose on a first come /first serve basis. Either way, you should see me after class to discuss your choice or pick a topic. A file with the presentation slides needs to be handed in on the day of the presentation.

Special materials required for the class, if any:

Technology Policy: Laptops and cell phones may be used during class for note taking and activities directly related to the course. All other use of laptops and cell phones is not permitted as it provides a distraction for other students.

Honor Code:

You are encouraged to discuss the presentations and reports with other students in ELEC 661. Each student, however, must turn in his or her own presentations/report. You should not look at the completed work of other students, and old quizzes and solutions.

Course Outline:

1. Introduction / overview
2. Overview of current challenges in sustainability (including third generation photovoltaic concepts, recent material developments, photocatalysis for solar-to-fuel generation/environmental remediation)

3. First round of student presentations
4. Nanophotonics approaches to challenges in sustainability (including materials design employing plasmonic approaches and nanophotonic light trapping approaches)
5. Reports on select topics
6. Discussion of reports
7. Nanophotonics, ultrafast and nanoscale spectroscopy (including Raman spectroscopy, SERS, transient absorption spectroscopy, femtosecond stimulated Raman spectroscopy, near-field scanning probe techniques)
8. Second round of student presentations

Absence policies:

Class attendance is required. It is the responsibility of the student who missed class to work with other students to review any material that is not represented in the online documents. There will be in-class quizzes (15%) which will be easy if you are around, and participation during class will count for 15%.

Students with Disabilities:

Any student with a documented disability seeking academic adjustments or accommodations is requested to speak with me during the first two weeks of class. All such discussions will remain as confidential as possible. Students with disabilities will need to also contact Disability Support Services in the Allen Center.

Information contained in this syllabus, other than the absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor.